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A Semiannual Status Report  
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The Multi-Ion, Multi-Event Test of Ion Cyclotron Resonance Heating

Ann M. Persoon, Principal Investigator

University of Iowa  
Department of Physics and Astronomy  
Iowa City, Iowa 52242

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Submitted by:

Ann M. Persoon  
Ann M. Persoon, Principal Investigator

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## A Multi-Ion, Multi-Event Test of Ion Cyclotron Resonance Heating

A Semiannual Status Report (May 8, 1993 - August 30, 1993)

The multi-ion, multi-event study of ion cyclotron resonance heating has been funded to study ion energization through ion cyclotron resonance with low frequency broadband electromagnetic turbulence. The initial work on the ion cyclotron resonance heating (ICRH) of oxygen ions was presented in Crew et al (1990). Crew and his co-authors developed a two-parameter representation of selected oxygen conic distributions and modelled the conic formation in terms of resonance heating. The first year of this study seeks to extend the work of Crew and his co-authors by testing the applicability of the ICRH mechanism to helium ion conic distributions, using data obtained from the Energetic Ion Composition Spectrometer and the Plasma Wave Instrument on Dynamics Explorer 1.

### A Study of the Ion Cyclotron Resonance Heating of Helium Conic Distributions: The First Four Months

Work began as soon as funding became available on May 8, 1993. Dr. Wei Feng assumed the position of programmer and began coordinating efforts to transfer the analysis and simulation software developed by Geoff Crew and John Retterer for the 1990 study of the cyclotron resonance heating of oxygen conics. Dr. Feng has worked with Dr. Retterer in successfully completing the transfer of the software and has been responsible for installing and adapting the software to run on the VAX and SUN workstations at the University of Iowa.

Dr. Feng has concentrated his efforts on the software which reproduces the plots in Crew et al. (1990) critical to the success of the ICRH theory: the calculation and the subtraction of the constant DC component in the low frequency electric field data (Figure 3); the electric field spectral density analysis and the power-law fitting code (Figure 4); the code which produces the ion conic distribution (Figure 9a); and the calculations of the velocity scale parameter and the pitch angle scaling parameter of the ion distribution (Figures 14a and 14b). The software packages which analyze the data and derive the appropriate parameters for the simulation were modified only slightly to adapt the software to the computer systems at the University of Iowa. Some updates have been made in the orbit-attitude data with particular attention to the most recent Dynamics Explorer spin vector information. Although the analysis software has required minimal modifications, Dr. Feng has had to create the display software in order to reproduce the plots shown in Crew et al. (1990).

At this time, all of the analysis software provided by Drs. Retterer and Crew have been installed and adapted to run on the VAX and SUN workstations at the University of Iowa. The wave and ion data used in the 1990 study of the cyclotron resonance heating of oxygen ion conics was also provided by Dr. Retterer and has been used to test the software. Display

software created by Dr. Wei Feng to reproduce the plots in Crew et al. (1990) is now fully developed and is being used to compare the output of the current programs with the published results. A few discrepancies have been found and are being studied. It is expected that the adapted software will be fully de-bugged within the next week or two.

#### Tasks Remaining:

Our next priority is to make the minor software adaptations necessary to analyze helium ion conic events. Dr. W. K. Peterson has identified a strong helium conic event in the Energetic Ion Composition Spectrometer data and has forwarded this data set to the University of Iowa. The preliminary analysis of this event will be the focus of a poster paper to be presented at the Fall AGU meeting in San Francisco.

By the end of December we expect to examine at least six or seven carefully selected helium ion conic events and use this database to test the applicability of the ICRH mechanism to this ion species. The results will be submitted to the Journal of Geophysical Research in January 1994.

#### References:

G. B. Crew, Tom Chang, J. M. Retterer, W. K. Peterson, D. A. Gurnett, and R. L. Huff, Ion cyclotron resonance heated conics: Theory and observations, J. Geophys. Res., 95, 3959, 1990.